FORM PTO-1390 (REV 5-93)	US DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTORNEY DOCKET NO. 2000-0617A
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 USC 371		U.S. APPLICATION NO. (If known, see 37 CFR 1.5) 09/582503

International Application No.	International Filing Date	Priority Date Claimed
PCT/EP99/00108	January 11, 1999	January 20, 1998

Title of Invention
ROTOR FOR AN ELECTRONICALLY COMMUTATED MOTOR AND IMPROVED METHOD FOR THE MASS PRODUCTION THEREOF

Applicant(s) For DO/EO/US
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Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 USC 371.

2. [] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 USC 371.

3. [X] This is an express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Articles 22 and 39(1).

4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. [X] A copy of the International Application as filed (35 USC 371(c)(2))
   a. [X] is transmitted herewith (required only if not transmitted by the International Bureau). Attachment A
   b. [] has been transmitted by the International Bureau.
   c. [] is not required, as the application was filed in the United States Receiving Office (RO/US).

6. [] A translation of the International Application into English (35 USC 371(c)(2)).

7. [] Amendments to the claims of the International Application under PCT Article 19 (35 USC 371(c)(3)).
   a. [] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [] have been transmitted by the International Bureau.
   c. [] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [] have not been made and will not be made.

8. [] A translation of the amendments to the claims under PCT Article 19 (35 USC 371(c)(3)).

9. [X] An executed oath or declaration of the inventor(s) (35 USC 371(c)(4)). Attachment B

10. [X] The annexes to the International Preliminary Examination Report under PCT Article 36 (35 USC 371(c)(5)). Attachment C

Items 11. to 16. below concern other document(s) or information included:

11. [] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [X] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included. Attachment D
13. [X] A FIRST preliminary amendment. Attachment E
    [] A SECOND or SUBSEQUENT preliminary amendment.
14. [] A substitute specification.
15. [] A change of power of attorney and/or address letter.
16. [X] Other items or information: Attachment F International Search Report

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) 09/582503	INTERNATIONAL APPLICATION NO. PCT/EP99/00108	ATTORNEY DOCKET NO. 2000-0617A	
17. [X] The following fees are submitted		CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)):			
[X] Search Report has been prepared by the EPO or JPO $840.00			
[] International preliminary examination fee paid to USPTO (37 CFR 1.482) $670.00			
[] No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $690.00			
[] Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO $970.00			
[] International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-33(4) . . . . . $ 96.00			
ENTER APPROPRIATE BASIC FEE AMOUNT =		$840.00	
Surcharge of $130.00 for furnishing the oath or declaration later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).		$	
Claims	Number Filed	Number Extra	Rate
Total Claims	8 - 20 =	0	X $18.00 $
Independent Claims	1 - 3 =	0	X $78.00 $
Multiple dependent claim(s) (if applicable)			+ $260.00 $
TOTAL OF ABOVE CALCULATIONS =		$840.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28) -		$	
SUBTOTAL =		$840.00	
Processing fee of $130.00 for furnishing the English translation later than [] 20 [] 30 months from the earliest claimed priority date (37 CFR 1.492(f)). +		$	
TOTAL NATIONAL FEE =		$840.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) ($40 per property). +		$40.00	
TOTAL FEES ENCLOSED =		$880.00	
		Amount to be refunded:	$
		charged:	$

a. [X] A check in the amount of $880.00 to cover the above fees is enclosed.

b. [] Please charge my Deposit Account No. 23-0975 in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 23-0975. A duplicate copy of this sheet is enclosed.

***NOTE*: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

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June 27, 2000
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Check No. 38687

2000-0617A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :

Fabrizio CARLI et al. :

Serial No. NEW : **Attn: Application Branch**

Filed June 27, 2000 : **Attorney Docket No. 2000-0617A**

ROTOR FOR AN ELECTRONICALLY COMMUTATED MOTOR AND IMPROVED METHOD FOR THE MASS PRODUCTION THEREOF

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

THE COMMISSIONER IS AUTHORIZED TO CHARGE THE FEE FOR ANY EXTRA CLAIMS FEE FOR THIS PAPER TO DEPOSIT ACCOUNT NO. 23-0975.

Sir:

Please amend the above-identified application as follows:

IN THE CLAIMS:

Please cancel claims 1-15 without prejudice or disclaimer.

Please add the following claims:

--16. Rotor for an electronically commutated motor that comprises:

a sub-assembly formed by a core of magnetic laminations and by a plurality of segments of a cylinder made of preferably sintered magnetizable materials positioned on the outer surface of the core,

a substantially cylindrical wrapper, made of a non-magnetic material preferably an austenitic steel, surrounding said segments of a cylinder, and having an inside diameter that is not smaller than the outside diameter of the said sub-assembly,

at least a pair of plane elements, in the form of rings made of a non-magnetic material, preferably aluminum, which are joined to the end portions of said wrapper at the extremities of the core first elastic means having a length that is not smaller that the length of the core, and are supported by means that are integrally provided in the core parallelly to the axis of rotation if the rotor, which are adapted to interfere with contiguous longitudinal edges of said segments of a cylinder so as to keep said segments circumferentially spaced from each other,

characterized in that it also comprises second elastic means which are supported by means that are integrally provided in the said core, adapted to ensure that the outer surface of the said segments keeps in contact with the inner surface of the wrapper and are the sole means provided in the rotor to make up for the longitudinal and radial plays of the various parts.

17. Rotor according to claim 1, characterized in that the supporting means for said second elastic means are grooves extending parallelly to the axis of rotation of the rotor and provided in a number that is equal to or a multiple of the number of the supporting means for said first elastic means.

18. Rotor according to claim 1, characterized in that said second elastic means are elementary undulated springs.

19. Rotor according to claim 1, characterized in that said second elastic means comprise a cylindric cage made of metal wire and consisting of first parallel, preferably undulated portions provided in a number equal to the supporting means thereof, second portions formed in the shape of arcs of a circle, and preferably undulated, which are subdivided into two groups of equal number between the ends of said first portions, and radial joining portions that are provided between the ends of each one of said first portions and the adjacent second portions.

20. Rotor according to claim 4, characterized in that the radial extension of said radial joining

portions is smaller than the thickness of the segments of a cylinder as measured on a plane that is orthogonal to the axis rotation of the rotor.

21. Rotor according to claim 1, characterized in that the means for supporting said first elastic means substantially consist of peripherally arranged slots that are provided, regularly spaced from each, on the outer surface of the core and have a cross-section in the shape of a "Ω", said slots being adapted to accommodate the first elastic means which are also in the shape of a "Ω" with their end portions bent to the shape of a "V" interfering with the contiguous longitudinal edges of the segments of a cylinder

22. Rotor according to claim 1, characterized in that the end portions of the wrapper are joined to said plane elements solely by means of a simple mechanical deformation.

23. Method for producing a rotor according to claim 1, comprising substantially the phases of:

making the core by stacking a plurality of magnetic laminations;

associating said second elastic means to respective supporting means integrally provided on the core;

obtaining a rotor sub-assembly formed by the core, said second elastic means, and the segments of a cylinder arranged along the outer surface of the core;

inserting the cylindrical wrapper along the axis of rotation around said rotor sub-assembly with a radial play with respect thereto;

inserting said first elastic means in the respective supporting means provided integrally on the core so as to obtain a circumferential spacing of the segments of a cylinder from each other due to the same first elastic means interfering with the contiguous longitudinal edges of the segments of a cylinder;

inserting said plane elements so as to enable them to come into contact with the end portions of the core;

submitting the end portions of the wrapper and/or the plane elements to a circumferential mechanical deformation so as to enable them to mutually join to form a cylindrical, substantially sealed shell;

magnetizing the rotor so as to enable the contiguous longitudinal edges of the segments of a cylinder to become opposite magnetic poles.--

REMARKS

The above amendments are submitted in response to the Reasoned Statement under article 35(2) issued December 3, 1999 by the International Preliminary Examination Report.

Respectfully submitted,

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ROTOR FOR AN ELECTRONICALLY COMMUTATED MOTOR AND IMPROVED METHOD FOR THE MASS PRODUCTION THEREOF

DESCRIPTION

The present invention refers to a rotor for electronically commutated motors.

Electronically commutated motors are becoming increasingly popular in many applications owing to the kind of efficiency and rpm-adjustment easiness that they usually offer.

Brushless-type electronically commutated motors are for instance being used to drive hermetic compressors of household refrigeration appliances, further to industrial equipment applications, in view of reducing the energy usage thereof.

A rotor for electronically commutated motors of this kind, as well as the methods and the equipment to produce it, is the subject of a number of a patent publications. In particular, US-A-5 040 286 and US-A-5 237 737 desclose a substantially closed rotor with a cylindrical core of magnetic steel laminations, a plurality of magnetizable sintered segments in the form of segments of a cylinder that have approximately the same length as said core and are adapted to be adhesive-bonded on to the outer surface thereof, a retaining wrapper obtained from a welded tube of non-magnetic stainless steel, and terminal closing rings made of aluminium.

The above cited retaining wrapper has an inside diameter that is smaller than the outside diameter of the rotor sub-assembly formed by the core and the magnetizable segments, as well as larger than the outside diameter of said terminal closing rings.

See APPENDIX

The drawbacks connected with these prior-art solutions derive mainly from the large dimensional tolerances of the magnetizable segments, so that the pressure exerted by the retaining wrapper is subject to considerable variations and the adhesive, which among other things needs quite a long time for hardening, must be applied in a particularly careful manner in order to ensure that it duly fills up the gaps or small sockets that are specially provided to that purpose. Furthermore, the ultimate shape of the rotor, as defined by the outer surface of the retaining wrapper, owing to the fact that the latter must at least partially follow the actual shape of the magnetizable segments, only seldom turns out to comply with the theoretical, ie. cylindrical one in practice, which introduces a few balancing problems.

All these drawbacks may quite easily pile up to constitute a considerable problem when the rotors have to be produced to as high output volumes as several thousands pieces per day, such as for instance in the case of motors used to drive the hermetic compressors of household refrigeration appliances. As a matter of fact, under these conditions it proves quite a difficult task to combine high quality and reduced production costs.

In view of doing away with some of these drawbacks, innovative design solutions have been developed by this same Applicant concerning the rotor of an electronically commutated brushless-type motor and disclosed in the Italian utility model applications nos. PN98U000003 filed on January 20, 1998 and PN98U000016 filed on March 10, 1998, whose contents are fully incorporated here.

It is a purpose of the present invention to provide a rotor of an electronically commutated motor, which may even be of a type differing from the brushless one,

EXHIBIT NR. 2

Appendix - to be attached at point of description

From EP-A-0 459 366 a rotor for an electronically commutated motor is also known where circumferential direction pressing members are interposed between a plurality of segment-shaped permanent magnets having the different poles and a die-casting material is filled into gaps where the the said pressing members are accomodated. No teaching is made in this reference concerning the insertion of a non-magnetic sleeve around the outer peripheries of the permanent magnets.

which is fit for mass production and, at the same time, optimizes the features that are claimed in the above cited Italian utility model applications.

A further purpose of the present invention is to provide a method enabling such a rotor to be mass produced to high quality standards, at reduced production costs and with the use of relatively simple tools and equipment.

These and further aims are reached when the rotor and the method to produce it have the features and characteristics as recited in the appended claims.

The invention will anyway be more readily understood and appreciated from the description of some preferred embodiments thereof which is given below by way of non-limiting example with reference to the accompanying drawings, in which

- Figure 1 is a simplified exploded view of a first embodiment of the rotor of an electronically commutated motor of the brushless type,

- Figure 2 is a view of the rotor of Figure 1, as seen according to the axis of rotation thereof;

- Figure 3 is a view of the same rotor as seen along the cross-sectional line III-III of Figure 2, wherein some parts are however illustrated in a simplified manner;

- Figure 4 is a same view as the one illustrated in Figure 2, however referred to a second embodiment of the rotor;

- Figure 5 is a three-dimensional view of a magnet retaining spring that may be used in both above mentioned embodiments of the rotor;

- Figure 6 is a longitudinal view of the spring shown in Figure 5;

- Figure 7 is a cross-sectional view of the spring of Figures 5 and 6.

As illustrated in Figure 2 and, albeit in a more simplified manner, also in Figures 1 and 3, in a first preferred embodiment a cylindrical stack of magnetic laminations forms the substantially cylindrical core 1 of a rotor, adapted to be joined with a shaft (not shown) which, in the case that the rotor is part of a brushless motor intended for driving a hermetic refrigerant compressor for refrigeration appliances, is in a generally known manner a common shaft for both the motor and the compressor. Each lamination is punched in such a manner as to ensure that three radial protrusions, for instance in the shape of a V, and six longitudinal notches with a substantially rectangular shape are provided along the periphery thereof, in addition to the usual notches and perforations that are provided to handling and centering purposes. The core 1, which is obtaining by stacking a plurality of laminations, is in this way provided with three longitudinal prismatic ribs 2, 3 and 4, spaced at 60°-angles from each other, as well as cylindrical channels 27. Only the grooves 14, 15 provided between the longitudinal ribs 2, 3 are shown in Figure 1, whereas also the grooves 16, 17 and 18, 19 provided between two other pairs of ribs 3, 4 and 4, 2, respectively, are shown in Figure 2.

The rotor further comprises:

- three segments of a cylinder 5, 6 and 7, which are made of a magnetizable material, preferably a sintering material for permanent magnets, as this is largely known to those skilled in the art. As this is explained to a greater detail farther on in this description, said segments of a cylinder 5, 6 and 7 are adapted to be fixed to the outer surface of the core 1 so as to form a so-called rotor sub-assembly. For this reason, each one of said segments of a cylinder 5, 6 and 7 has an inside diameter that is substantially the same as the diameter of the outer surface of the core 1, in the zones comprised between the longitudinal ribs 2, 3 and 4, and an amplitude that is slightly less than 120°. Furthermore, the longitudinal edges thereof are provided with bevels that are respectively oriented towards the axis of rotation X and the exterior of the rotor (see Figure 2);

- three spring clips 11, 12 and 13, made out of music steel strips, that are called centering springs in this description. As clearly shown in the enlarged-scale detail appearing in Figure 2, which illustrates the spring clip 11 associated to the rib 4, the centering springs 11, 12 and 13 have a V-shaped cross-section corresponding to the shape of the bevels provided along the longitudinal edges of the segments of a cylinder 5, 6 and 7 facing the axis X of the rotor. Anyway, the transverse dimension T of the centering springs 11, 12 and 13 is not smaller than the width of the longitudinal ribs 2, 3 and 4 (regardless of the actual shape of such ribs) along the circumference of the core 1, whereas their length is preferably smaller than or equal to the height H of the core 1 (see Figure 1);

- two end rings 8 and 9 made of a non-magnetic metal, for instance aluminium, that are provided with centering bulges 28 and 29;

- a cylindrical retaining wrapper 10, made of a non-magnetic metal, such as for instance AISI 304 steel, having a length L which is greater than the height H of the core 1 and an inside diameter that is greater than or equal to the outside diameter of the rings 8 and 9;

- a plurality of corrugated spring clips, that are referred to as retaining springs and indicated at 21 through to 26 (see Figure 2) in this description, which are made out of music steel wire. Each one of these springs is adapted to be inserted in one of said longitudinal grooves 14-19 of the core 1. Figure 3 shows for instance the corrugated spring 21 inserted in the groove 14.

In view of producing a rotor as described above, and illustrated in Figures 1 to 3, a preferred method according to the present invention comprises the following phases:

1) realization of the core 1 by stacking a plurality of magnetic laminations so as to obtain the above indicated characteristics;

2) insertion of the retaining springs 21-26 in the longitudinal grooves 14-19 of the core 1;

3) obtainment of a rotor sub-assembly formed by the core 1, the retaining springs 21-26, and the segments of a cylinder 5, 6 and 7 arranged along the outer surface of the core 1. Owing to the action exerted by the retaining springs 21-26 upon the segments of a cylinder 5, 6 and 7, this phase is carried out without any use of adhesives, unlike what on the contrary happens when prior-art production methods are used, and this proves to be particularly advantageous in the case of very large output quantities, since it enables the rotor to be produced at clearly enhanced daily productivity rates;

4) insertion of the cylindrical wrapper 10 along the axis of rotation X around said rotor sub-assembly. Owing to the presence of an intentionally provided radial play, due to an inside diameter having been selected for the wrapper 10 which is greater than or equal to the outside diameter of the rotor sub-assembly, even this phase of the method according to the present invention can be carried out without encountering any particular difficulty, while again contributing to a reduction in manufacturing time requirements. The outer surface of the wrapper 10 is in this way capable of maintaining a cylindrical shape and, as a result, the rotor can be balanced in a much easier manner. In turn, the retaining springs 21-26 make up for the longitudinal and radial plays introduced by the different dimensional tolerances of the various parts. In this way, the outer surface of the segments of a cylinder 5, 6 and 7 is able to stay in contact with the inner surface of the wrapper 10, whereas the inner surface thereof may also be slightly spaced from the outer surface of the core 1. During the operation of the motor, the centrifugal force is in this way directed in the same direction as the one of the action exerted by the retaining springs 21-26, thereby minimizing the risk for the segments of a cylinder 5, 6 and 7 to break down, considering that, being these segments made of sintered metal, they have a relatively low mechanical strength;

5) insertion of the centering springs 11, 12 and 13 along the axis of rotation X (as indicated by the three parallel arrows appearing in Figure 1) starting from an

end side of the wrapper 10, so as to enable them to be supported by the ribs 2, 3 and 4 and, as this has already been described above, so as to enable them to interfere with the bevels facing the axis X of the rotor provided on the contiguous longitudinal edges of the segments of a cylinder 5, 6 and 7. A precise circumferential spacing between the segments of a cylinder 5, 6 and 7 is in this way obtained in the rotor, without any risk for said segments to come into contact with each other, said circumferential spacing playing a quite important role in enabling a high electric efficiency of the motor to be obtained;

6) insertion of the rings 8 and 9 so as to enable them to come into contact with the end portions of the core 1, without interfering with the end portions of the wrapper 10;

7) circumferential deformation of the end portions of the wrapper 10 onto the rings 8 and 9, so as to enable them to be mutually joined by a seam-folding operation that brings about a cylindrical, substantially sealed shell around the core 1 of the rotor (in this connection, it should be pointed out that, for reasons of greater simplicity, the rotor is shown in Figure 3 as it appears before this phase is carried out);

8) magnetization of the rotor so as to enable the contiguous longitudinal edges of the segments of a cylinder 5, 6, 7 to become opposite magnetic poles (see Figure 1).

A second embodiment of the rotor according to the present invention is illustrated in Figure 4.

With respect to the afore described first embodiment, the rotor remains practically unchanged in the following features thereof:

- the three segments of a cylinder, made of a magnetizable material, which are now indicated with the reference numerals 31, 32 and 33;

- the two terminal rings, made of a non-magnetic material, of which only the one now indicated at 34 is shown;

- the cylindrical wrapper, which is also made of a non-magnetic metal material and is now indicated at 36;

- the retaining springs, which are now indicated at 37 through to 42.

As compared with the afore described first embodiment, this second embodiment introduces following variants:

- the core 30, which is still formed by a stack of magnetic laminations, is provided, further to the longitudinal grooves regularly spaced from each other by an angle of 60°, and now indicated at 43 through to 48 in the Figure, for the retaining springs 37-42, with three peripheral slots 49, 50 and 51. Said slots, that have a cross-section in the shape of substantially a Ω and are spaced from each other by an angle of 120°, extend for a relativily short radial length starting from the outer surface of the core 30;

- the three centering springs, which are now indicated at 52, 53 and 54 in the Figure, have a cross-section in the shape of a Ω and are so sized as to be able to be accomodated in the peripheral slots 49, 50 and 51 of the core 30, with the end portions thereof that are bent to a shape of a V so as to be adapted to interfere withthe bevels facing the axis of the rotor that are provided along the contiguous longitudinal edges of the segments of a cylinder 31, 32 and 33. These features are evidenced in the detail illustrated to an enlarged scale in Figure 4, which only shows the slot 49 and the therewith associated centering spring 52 with its bent end portions 55 and 56. For reasons of greater simplicity, no mention is made here of items that are equal to or unchanged with respect to the ones that have already been described in connection with the afore cited first embodiment, as long as they have no direct relevance with the present invention.

The manufacturing method for this second embodiment of the rotor according to the present invention is substantially the same as the one described in connection with the afore cited first embodiment, of which it maintains the basic features and particular advantages. In particular, the insertion of the wrapper 36 around the rotor sub-assembly is facilitated by the fact that the inside diameter of the former is not smaller than the outside diameter of the latter; the longitudinal and radial plays that are introduced by the different dimensional tolerances of the various parts of the rotor are made up for by the retaining springs 37-42, which ensure that the outer surface of the segments of a cylinder 31, 32 and 33 is able to remain in contact with the inner surface of the wrapper 36; the action exerted by the bent, V-shaped ends of the centering springs 52, 53 and 54, owing to the interference thereof, ensures that a precise circumferential spacing is maintained between the segments of a cylinder 31, 32 and 33.

A variant of the above embodiments is illustrated in the Figures 5 to 7, in which the use is advantageously provided of a single retaining spring 60, made of steel music wire and shaped to a configuration of a "cylindric cage", instead of the plurality of the afore described elementary retaining springs. Said retaining spring 60 consists of:

- first parallelly extending portions, indicated at 61 through to 66 in the Figures, provided in an equal number as the corresponding grooves on the periphery of the rotor core (ie. six in this particular example of embodiment) - see Figures 5 and 6;

- second portions in the shape of arcs of a circle, and indicated at 67 through to 72 in the Figures, which are subdivided into two groups of equal number between the ends of said first portions 61-66 (ie. three plus three in this particular example of embodiment) - see Figure 5;

- short radial joining portions, indicated at 73 through to 84 in the Figures, which are provided between the ends of each one of said first portions 61-66 and the adjacent second portions 67-72 (see Figure 7), so that they are of course

provided in a number that is the double of the number thereof (ie. in the number of twelve in this example of embodiment) - see Figure 5.

Further features of the retaining spring 60 are as follows:

- both said first portions 61-66 and said second portions 67-72 are not rectilinear, but undulated, ie. a fact that increases the elastic yielding property thereof in all directions and, therefore, the capability thereof of making up for the different dimensional tolerances of the various parts (see Figures 5 and 6);

- the length thereof (ie. the distance between the two groups of second portions 67-72) is substantially equal to the height H of the rotor core (see Figure 5).

- the radial extension of the joining portions 73-84 is smaller than the thickness of the segments of a cylinder of the rotor sub-assembly, as measured on a plane that is orthogonal to the axis of rotation thereof.

The use of a single retaining spring 60 enables all of the segments of a cylinder to be at the same time and most precisely positioned around the core. When adding this feature to the other afore cited advantages, the possibility emerges of further increasing both the manufacturing productivity and the quality of the rotor.

It will be appreciated that further embodiments and variants of the present invention, in particular as far as such features are concerned as the number as the shape of the segments of a cylinder (or any other type of magnetizable elements of the rotor sub-assembly), the centering springs, the retaining springs, the construction of the core, the method for joining the wrapper and the rings (or any other end elements that may be used), may be developed in any different manner by those skilled in the art without departing from the scope of the present invention.

CLAIMS

1. Rotor for an electronically commutated motor, in particular for driving a refrigerant hermetic compressor, that comprises :

- a core (1; 30) formed by a cylindrical stack of magnetic laminations,
- a plurality of segments of a cylinder (5, 6, 7; 31, 32, 33) made of preferably sintered magnetizable materials, provided on their contiguous longitudinal edges with bevels that are preferably facing the axis (X) of the rotor
- a substantially cylindrical wrapper (10; 36), made of a non-magnetic material, preferably an austenitic steel., surrounding said segments of a cylinder (5, 6, 7; 31, 32, 33) when these are positioned on the outer surface of the core (1; 30),
- at least a pair of plane elements (8, 9; 34, 35) joined to the end portions of said wrapper (10; 36) at the extremities of the core (1; 30),
- first elastic means (11, 12, 13; 52, 53, 54) having a length (L) that is not smaller than the length (H) of the core (1; 30), and are supported by means (2, 3, 4; 49, 50, 51) that are integrally provided in the core (1; 30) parallel to the axis of rotation (X) of the rotor, which interfere with contiguous longitudinal edges of said segments of a cylinder (5, 6, 7; 31, 32, 33) so as to keep said segments circumferentially spaced from each other,

characterized in that the said cylindrical wrapper (10; 36) has an inside diameter that is not smaller than the outside diameter of the rotor sub-assembly formed by the core (1; 30) and the segments of a cylinder (5, 6, 7; 31, 32, 33).

2. Rotor according to claim 1, characterized in that it also comprises second elastic means (21-26; 37-42; 60), supported by means (14-19; 43-48) that are

integrally provided in the core (1; 30), which are adapted to ensure that the outer surface of the segments of a cylinder (5, 5, 7; 31, 32, 33) keeps in contact with the inner surface of the wrapper (10; 36).

3. Rotor according to claim 1 or 2, characterized in that (2, 3, 4) that the core (1) is integrally provided at its outer surface with peripherally arranged ribs that are regularly spaced from each other as means for supporting said first elastic means (11, 12, 13).

4. Rotor according to claim 3, characterized in that said first elastic means (11, 12, 13), and their associated supporting ribs (2, 3, 4) as well, have a cross-section in the shape of substantially a "V".

5. Rotor according to claim 1 or 2, characterized in that the core (1) is integrally provided at its outer surface with peripherally arranged slots (49, 50, 51) that are provided, regularly spaced from each other, with a cross-section in the shape of a "Ω" in order to accommodate and support the first elastic means (52, 53, 54) which are also in the shape of a "Ω" with their end portions bent to the shape of a "V" interfering with the contiguous longitudinal edges of the segments of a cylinder (31, 32, 33).

6. Rotor according to any claim 2 to 5, characterized in that the supporting means (14-19; 43-48) for said second elastic means (21-26; 37-42; 60) are grooves extending parallel to the axis of rotation (X) of the rotor and provided in a number that is equal to or a multiple of the number of the supporting means (2, 3, 4; 49, 50, 51) for said first elastic means (11, 12, 13; 52, 53, 54).

7. Rotor according to any claim 2 to 6, characterized in that said second elastic means (21-26; 37, 42) are elementary undulated springs which are supported by the core (1, 30) without using any adhesive or similar material .

8. Rotor according to any claim 2 to 6, characterized in that said second elastic means (60) comprise a cylindrical cage made of metal wire and consisting of first

parallel, preferably undulated portions (61-66) provided in a number equal to the supporting means (14-19; 43-48) thereof, second portions (67-72) formed in the shape of arcs of a circle, and preferably undulated, which are subdivided into two groups of equal number between the ends of said first portions (61-66), and radial joining portions (73-84) that are provided between the ends of each one of said first portions (61-66) and the adjacent second portions (67-72).

9. Rotor according to claim 8, characterized in that the radial extension of said joining portions (73-84) is smaller than the thickness of the segments of a cylinder (5, 6, 7; 31, 32, 33) as measured on a plane that is orthogonal to the axis of rotation (X) of the rotor.

10. Rotor according to any of the preceding claims where the said plane elements (8, 9; 34, 35) are in the form of rings made of a non-magnetic material, preferably aluminium, characterized in that the end portions of the wrapper (10; 36) are joined to said plane elements (8, 9; 34, 35) by means of a simple mechanical deformation, without any use of foreign bonding and/or sealing materials.

11. Method for producing a rotor according to any of the preceding claims, comprising substantially the phases of:

- making the core (1; 30) by stacking a plurality of magnetic laminations;

-associating said second elastic means (21-26; 37-42; 60) to respective supporting means (14-19; 43-48) integrally provided on the core;

- obtaining a rotor sub-assembly formed by the core (1;30), said second elastic means (21-26; 37, 42; 60), and the segments of a cylinder (5, 6, 7; 31, 32, 33) arranged along the outer surface of the core (1; 30);

- inserting the cylindrical wrapper (10; 36) along the axis of rotation (X) around said rotor sub-assembly with a radial play with respect thereto;

- inserting said first elastic means (11, 12, 13; 52, 53, 54) in the respective supporting means provided integrally on the core (1; 30) so as to obtain a circumferential spacing of the segments of a cylinder (5, 6, 7; 31, 32, 33) from each

other due to the same first elastic means (11, 12, 13; 52, 53, 54) interfering with the contiguous longitudinal edges of the segments of a cylinder (5, 6, 7; 31, 32, 33);

- inserting said plane elements (8, 9; 34, 35) so as to enable them to come into contact with the end portions of the core (1, 30);

- submitting the end portions of the wrapper (10; 36) and/or the plane elements (8, 9; 34, 35) to a circumferential mechanical deformation so as to enable them to mutually join to form a cylindrical, substantially sealed shell;

- magnetizing the rotor so as to enable the contiguous longitudinal edges of the segments of a cylinder (5, 6, 7; 31, 32, 33) to become opposite magnetic poles.

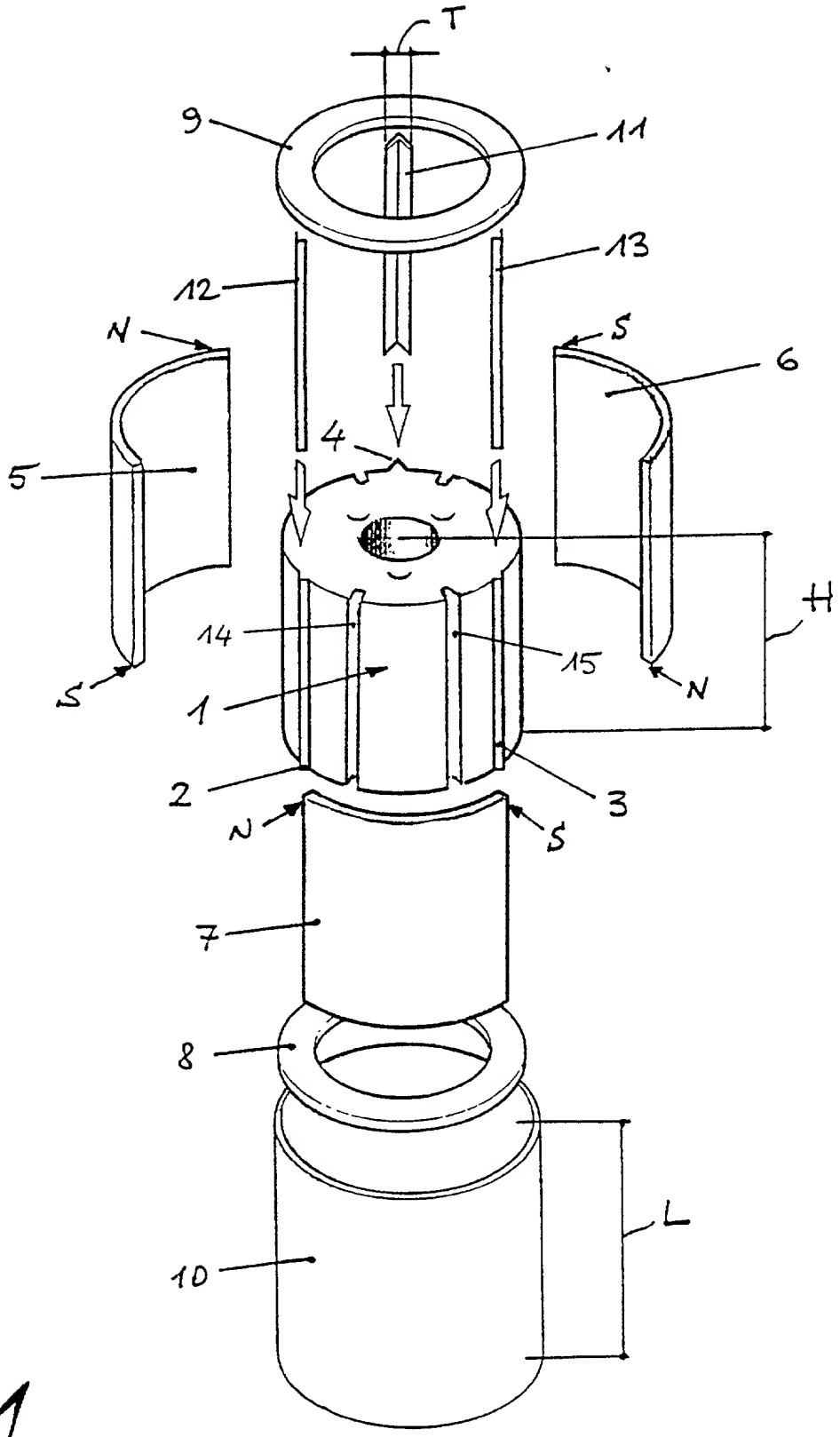

FIG. 1

FIG.2

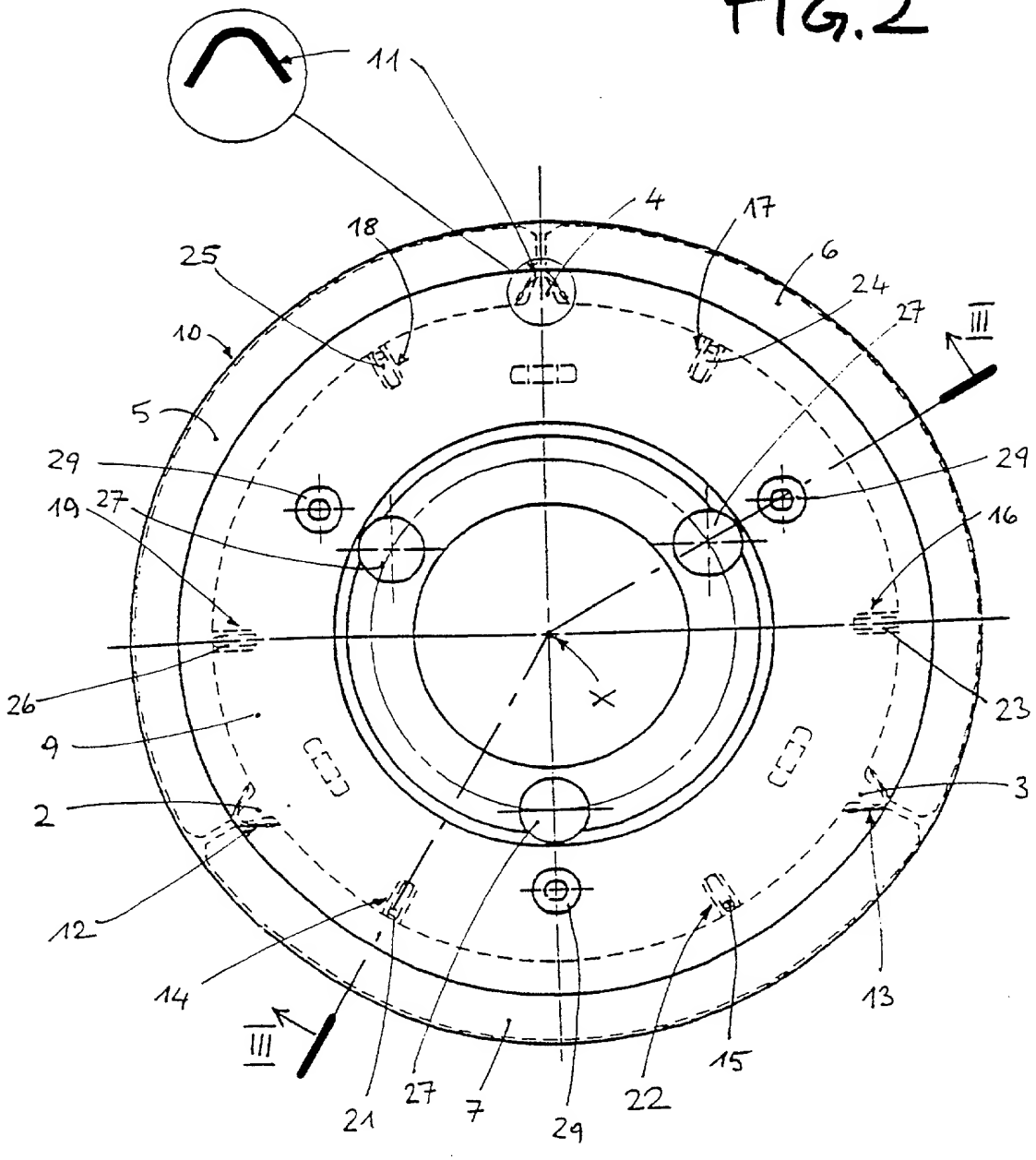
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FIG.3

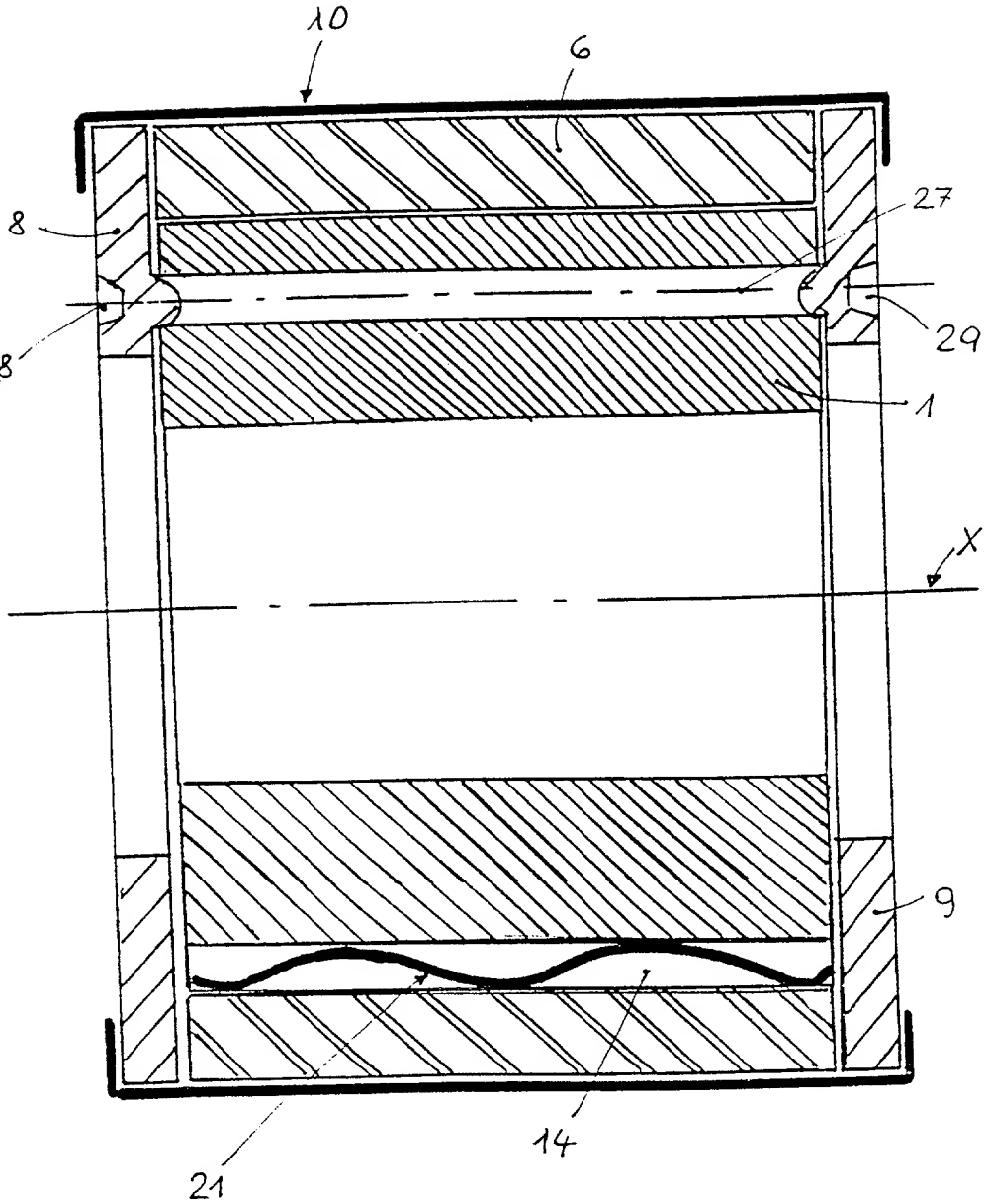
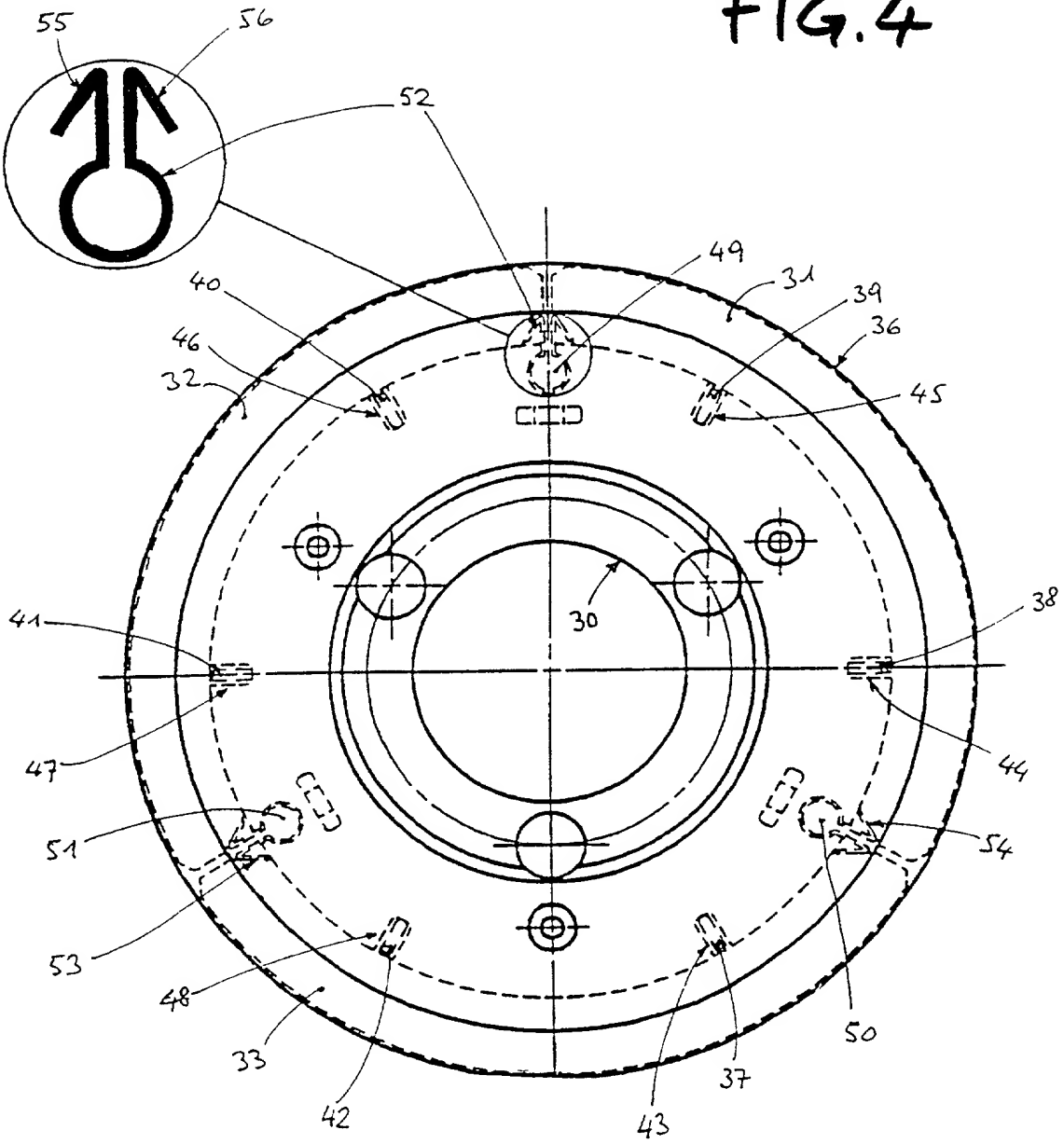


FIG.4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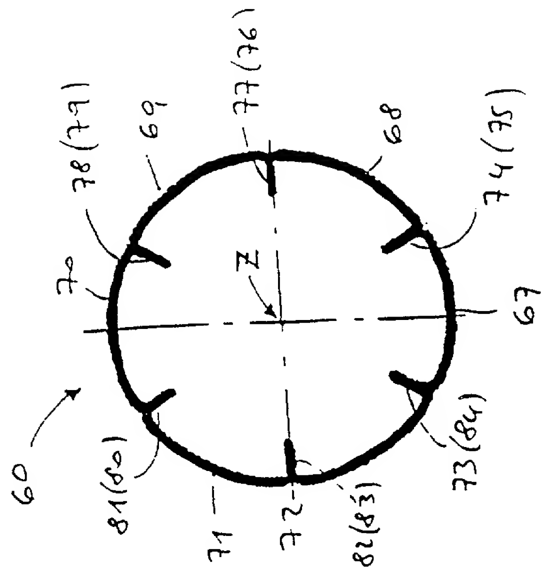

FIG.7

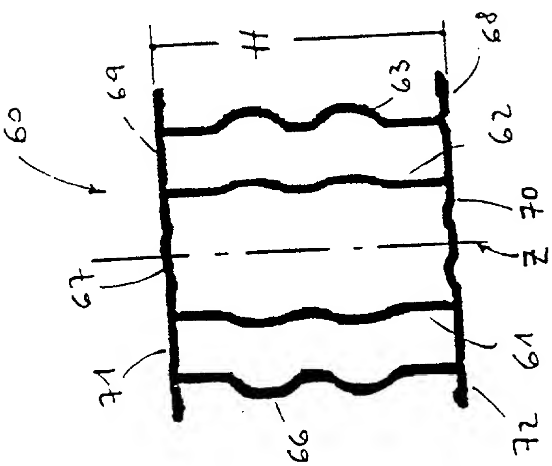

FIG.6

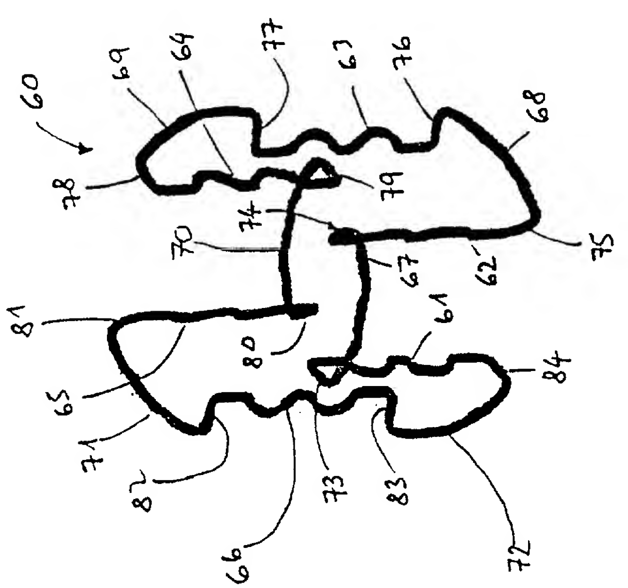

FIG.5

DECLARATION AND POWER OF ATTORNEY FOR U.S. PATENT APPLICATION

() Original () Supplemental () Substitute (X) PCT () DESIGN

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Title: ROTOR FOR AN ELECTRONICALLY COMMUTATED MOTOR AND IMPROVED METHOD FOR THE MASS PRODUCTION THEREOF

of which is described and claimed in:
() the attached specification, or
() the specification in application Serial No. , filed , and with amendments through (if applicable), or
(X) the specification in International Application No. PCT/EP99/00108, filed January 11, 1999, and as amended on October 18, 1999 (if applicable).

I hereby state that I have reviewed and understand the content of the above-identified specification, including the claims, as amended by any amendment(s) referred to above.

I acknowledge my duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code, §119 (and §172 if this application is for a Design) of any application(s) for patent or inventor's certificate listed below and have also identified below any application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

COUNTRY	APPLICATION NO.	DATE OF FILING	PRIORITY CLAIMED
Italy	PN98U000003	January 20, 1998	Yes
Italy	PN98U000016	March 10, 1998	Yes
Italy	PN98A000070	October 6, 1998	Yes

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code §112, I acknowledge the duty to disclose information material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NO.	U.S. FILING DATE	STATUS: PATENTED, PENDING, ABANDONED

And I hereby appoint Michael R. Davis, Reg. No. 25,134; Matthew M. Jacob, Reg. No. 25,154; Jeffrey Nolton, Reg. No. 25,408; Warren M. Cheek, Jr., Reg. No. 33,367; Nils Pedersen, Reg. No. 33,145; and Charles R. Watts, Reg. No. 33,142, who together constitute the firm of WENDEROTH, LIND & PONACK, L.L.P., jointly and severally, attorneys to prosecute this application and to transact all business in the U.S. Patent and Trademark Office connected therewith.

I hereby authorize the U.S. attorneys named herein to accept and follow instructions from Propria S.r.l. as to any action to be taken in the U.S. Patent and Trademark Office regarding this application without direct communication between the U.S. attorneys and myself. In the event of a change in the persons from whom instructions may be taken, the U.S. attorneys named herein will be so notified by me.

I further declare that all statements made herein of my own knowledge are true, and that all statements on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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Fabrizio CARLI

2nd Inventor Matteo Bello Date June 6, 2000
Matteo BELLOMO

3rd Inventor _____ Date _____

4th Inventor _____ Date _____

5th Inventor _____ Date _____

6th Inventor _____ Date _____

The above application may be more particularly identified as follows:

U.S. Application Serial No. _____ Filing Date June 27, 2000

Applicant Reference Number ZEM.98.274 Atty Docket No. 00326/ 2000_0617A

Title of Invention ROTOR FOR AN ELECTRONICALLY COMMUTATED MOTOR AND IMPROVED METHOD FOR THE MASS PRODUCTION THEREOF

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Post Office Address	ADDRESS	CITY	STATE OR COUNTRY	ZIP CODE